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GEOMETRIC BIAS CALIBRATION OF THE INSTRUMENTS LINE-OF-SIGHT FRAME AND ITS APPLICATION IN SCIENTIFIC OBSERVATION IN THE SVOM MISSION

Abstract

The Space-based mlti-band Variable Objects Monitor (SVOM) mission is a Sino-French collaborative mission designed to detect and rapidly locate gamma-ray bursts (GRBs). The space-based instrumentation in the SVOM mission includes ECLAIRs, a low-energy gamma-ray imager and spectrometer; GRM, a gamma-ray spectrometer; MXT, a low-energy X-ray telescope; and VT, an optical telescope. Joint observations among these four instruments are critical to achieve the mission's scientific objectives. During the GRB localization process, ECLAIRs detects and initially locates potential GRBs. If the signal exceeds the predefined detection threshold, a slew request is sent. GRM, which operates in a different energy range than ECLAIRs, also detects potential GRB sources and provides localization information to ECLAIRs. If on-board conditions are satisfied, the satellite maneuvers toward the target source. Once the slew maneuver is completed and observation stability is achieved, MXT refines the localization of the GRB, while VT begins capturing images of the target. To ensure the success of this observation sequence, it is assumed that the bias matrices between the ECLAIRs line-of-sight (LOS) frame and the VT LOS frame are sufficiently accurate and considered when perform the slew. This ensures that, after the platform's slew maneuver, the GRB source will be within the field of view (FOV) of VT. Additionally, if MXT provides more precise GRB localization, the satellite performs a second slew to position the source closer to the center of VT's FOV. This process also assumes reasonable accuracy of the bias matrix between the MXT LOS frame and the VT LOS frame. Therefore, the calibration of bias matrices between the scientific instruments, as well as between VT and the satellite's star trackers (for attitude determination), is essential for the automatic observation and localization of GRBs in the SVOM mission. These bias matrices are defined in the SVOM system requirement documents during system and mission analysis, with all contributing factors either analyzed, simulated, or tested before launch. In-orbit calibration of the bias matrices has been successfully performed after launch, meeting system requirements and enabling further scientific observations. This paper presents the methods used for calibration, along with the in-orbit calibration results. The post-launch calibration results are compared with ground analysis and test results, providing valuable insights and lessons learned from the mission.